General

Guideline Title

ACR Appropriateness Criteria® nonischemic myocardial disease with clinical manifestations (ischemic cardiomyopathy already excluded).

Bibliographic Source(s)

Mammen L, Woodard PK, Abbara S, Dorbala S, Javidan-Nejad C, Julsrud PR, Kirsch J, Kramer CM, Krishnamurthy R, Laroia AT, Shah AB, Vogel-Claussen J, White RD, Expert Panel on Cardiac Imaging. ACR Appropriateness CriteriaÂ® nonischemic myocardial disease with clinical manifestations (ischemic cardiomyopathy already excluded). [online publication]. Reston (VA): American College of Radiology (ACR); 2013. 11 p. [67 references]

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Nonischemic Myocardial Disease with Clinical Manifestations (Ischemic Cardiomyopathy Already Excluded)

Variant 1: Suspected arrhythmogenic cardiomyopathy.

Radiologic Procedure	Rating	Comments	RRL*
MRI heart function and morphology without and with contrast	9	See statement regarding contrast in text below under "Anticipated Exceptions."	O
US echocardiography transthoracic resting	8		O
MRI heart function and morphology without contrast	7		O
CT heart function and morphology with contrast	4	This procedure is an alternative to MRI if the patient has a pacemaker or other contraindication.	*Relative Radiation Level

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

Radiologic Procedure	Rating	Comments	RRL*
Coronary angiography with ventriculography	3		
CT chest without contrast	2		
MRI chest without and with contrast	2		O
MRI chest without contrast	2		O
Tc-99m V/Q scan lung	2		
X-ray chest	1		
FDG-PET heart	1		
CT coronary calcium	1		
US echocardiography transesophageal	1		O
Arteriography pulmonary	1		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Suspected myocardial infiltrative disease.

Radiologic Procedure	Rating	Comments	RRL*
MRI heart function and morphology without and with contrast	9	See statement regarding contrast in text below under "Anticipated Exceptions."	O
US echocardiography transthoracic resting	8		O
X-ray chest	7		
FDG-PET heart	7	This procedure is as good as MRI for initial diagnosis of sarcoidosis and better than MRI for follow-up.	
MRI heart function and morphology without contrast	6		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		Repeat studies are appropriate for associated valve disease.	*Relative

Radiologic Procedure	Rating	Comments	RRL*
CT heart function and morphology with contrast	4	This procedure is an alternative to MRI if the patient has a pacemaker or other contraindication to MRI.	
CT coronary calcium	2		
Tc-99m V/Q scan lung	2		
Coronary angiography with ventriculography	2		
CT chest without contrast	1		
MRI chest without and with contrast	1		O
MRI chest without contrast	1		O
Arteriography pulmonary	1		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Suspected hypertrophic cardiomyopathy.

Radiologic Procedure	Rating	Comments	RRL*
MRI heart function and morphology without and with contrast	9	See statement regarding contrast in text below under "Anticipated Exceptions".	O
US echocardiography transthoracic resting	9		O
Coronary angiography with ventriculography	8	Perform this procedure prior to alcohol septal ablation or to assess left ventricular pressure and gradients.	
US echocardiography transesophageal	7	Perform this procedure to assess left atrial appendage for thrombus prior to cardioversion or in patients with implantable devices and poor acoustic windows.	O
MRI heart function and morphology without contrast	7		O
CT heart function and morphology with contrast	4	This procedure is an alternative to MRI if the patient has a pacemaker or other contraindication.	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation

Radiologic Procedure	Rating	Comments	RRL*
FDG-PET heart	3		
CTA chest with contrast	2		
MRI chest without contrast	2		O
X-ray chest	1		
CT chest without contrast	1		
Tc-99m V/Q scan lung	1		
CT coronary calcium	1		
MRI chest without and with contrast	1		O
Arteriography pulmonary	1		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Suspected acute/subacute myocardial disease.

Radiologic Procedure	Rating	Comments	RRL*
MRI heart function and morphology without and with contrast	8	See statement regarding contrast in text below under "Anticipated Exceptions."	O
US echocardiography transthoracic resting	8		O
X-ray chest	7	Perform this procedure to assess systemic inflammation.	
MRI heart function and morphology without contrast	6	Perform this procedure if contrast cannot be given or if right disease is suspected.	O
US echocardiography transesophageal	4	Perform this procedure primarily to assess left atrial thrombus.	O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative
Coronary angiography with			

Radiologic Procedure	Rating	Comments	RRL*
ventriculography			
CT heart function and morphology with contrast	2		
CTA chest with contrast	2		
MRI chest without and with contrast	2		O
MRI chest without contrast	2		O
FDG-PET heart	2	This procedure may be considered in select cases to look for inflammatory causes of myocarditis-like disorders.	
CT chest without contrast	1		
CT coronary calcium	1		
Tc-99m V/Q scan lung	1		
Arteriography pulmonary	1		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction/Background

Symptomatic myocardial disease, which is not the result of flow-limiting coronary artery disease or prior myocardial infarction, is commonly referred to as nonischemic myocardial disease or cardiomyopathy (CM). Clinical manifestations of nonischemic myocardial disease include arrhythmia, palpitations, heart failure, shortness of breath, dyspnea, lower extremity edema, ascites, syncope, and chest discomfort. At times, the symptoms are so generalized and/or nonspecific that it may be difficult to identify myocardial disease as the etiology of the illness. Early and accurate detection and characterization of myocardial disease therefore becomes critical for appropriate patient treatment and management and to potentially avoid disease progression.

Nonischemic CM is more common in women and younger individuals. In general, the prognosis of nonischemic myocardial disease or CM is better than in ischemic myocardial disease or CM, although specific therapy such as revascularization may improve symptoms in the latter. Cardiac dysfunction can further be classified as systolic or diastolic or a combination of both. Most commonly the left ventricle (LV) is affected, but the right ventricle (RV) can also be affected in certain disease states. Systolic heart failure is diagnosed when there is reduction in the ventricular

ejection fraction. Symptoms of heart failure occur when the degree of myocardial dysfunction exceeds compensatory mechanisms that occur to maintain adequate cardiac output and oxygenation. An LV ejection fraction (LVEF) less than 50% is below normal range, but some patients are asymptomatic with even lower ejection fractions. Nonischemic myocardial disease can also be secondary to other cardiac or systemic disease processes, such as valvular disease or recurrent tachyarrhythmia.

Conversely, heart failure with normal systolic function, also referred to as diastolic heart failure, is an increasingly recognized illness. There is a growing body of literature regarding diastology, which is the study of relaxation of the myocardium. Various diseases produce diastolic dysfunction and result in inadequate relaxation and filling of the ventricle(s). Myocardial fibrosis and infiltrative diseases such as amyloid and sarcoid are examples. Alternatively, there may be pericardial disease causing constriction of the cardiac chambers, resulting in inadequate diastolic filling. Symptoms of diastolic abnormality may be typical for congestive heart failure as well as symptoms of right heart failure, which include ascites, hepatic congestion, and lower extremity edema.

Overview of Imaging Modalities

In most cases of systolic heart failure, ischemic CM should be considered and excluded prior to assessment for nonischemic CM. Echocardiography (echo) is the mainstay of evaluating left ventricular function due to ease of access and widespread use. Valvular function and diastolic function can also be evaluated. Advanced echo techniques such as pulsed tissue Doppler imaging and 3-dimendional (3-D) imaging have added diagnostic and prognostic value in the evaluation of nonischemic CM. Stress physiology assessment via treadmill exercise, rest and stress radionuclide myocardial perfusion imaging (SPECT MPI), or stress echo are also commonly used in the evaluation of CM primarily to exclude ischemic etiologies. Dobutamine and adenosine stress functional cardiac magnetic resonance imaging (MRI) provide high sensitivity and specificity for ischemia. If these studies are inconclusive, coronary angiography with ventriculography may be considered. In cases of low-to-intermediate likelihood for coronary artery disease, coronary computed tomography angiography (CCTA) can be performed for direct coronary artery evaluation to differentiate ischemic versus nonischemic CM. Since elevated pulmonary arterial pressure is a predictor of death in patients with heart failure, echo and/or right heart catheterization may be considered. Evaluating right heart pressures is also useful in evaluating restrictive cardiomyopathies.

Recent advances in technology allow further reduction of radiation dose from CCTA; newly available dose-reducing techniques include prospective triggering, adaptive statistical iterative reconstruction, and high-pitch spiral acquisition. These new lower-dose techniques are appropriate in patients with low heart rates (<65 bpm) who are in sinus rhythm. If function evaluation is desired, the retrospective gating technique must be utilized. If chronic pulmonary embolism is being considered, a chest CTA can be performed. Alternatively, a ventilation perfusion examination can be done if a patient has contraindication to iodinated contrast. The role of positron emission tomography (PET) in the assessment of cardiac sarcoidosis is well established, and its role in cardiomyopathies has been studied to a limited extent for the localization of scar for cardiac resynchronization therapy.

Coronary calcium scoring (CCS) is most commonly used for risk stratification in asymptomatic patients. In a large study of 10,377 subjects it has been shown that CCS provides independent incremental information in addition to traditional risk factors in the prediction of all-cause mortality.

Cardiac MR (CMR) imaging has emerged as a powerful tool for the diagnosis of ischemic and nonischemic cardiomyopathies. It is now considered the reference standard imaging technique to assess myocardial anatomy, regional and global function, and viability—and often reveals the underlying etiology of heart failure. CMR allows a multifaceted approach for the evaluation of new onset heart failure. Advanced MRI techniques with tissue imaging and delayed myocardial enhancement can provide information beyond echo for tissue characterization in CM.

In nonischemic CM, delayed myocardial enhancement usually does not occur in a coronary artery distribution and is often mid wall or subepicardial rather than subendocardial or transmural. Localization of pathology can also guide myocardial biopsy to the affected area, increasing its yield. In addition, MRI is increasingly being used for evaluation of genetically positive, phenotypically negative patients for risk stratification, and the prognostic value of delayed enhancement in CMR has been described.

Variant: Suspected Arrhythmogenic Cardiomyopathy

A patient may suffer from palpitations, and electrocardiogram (ECG)/Holter monitoring may reveal a pattern of arrhythmias, which may indicate a need to exclude underlying structural heart disease. Arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVC/D) is caused by genetic mutations, which result in fibrofatty infiltration of the myocardium, most often the RV. RV dilation and dysfunction are hallmarks of ARVC/D and set the stage for life-threatening arrhythmias. Morphologic and genetic variants of this disease have been investigated. Advances in echo techniques have aided evaluation of the right heart. CT can also provide a significant role in morphologic evaluation of the RV, particularly in patients with implantable cardioverter-defibrillators (ICD) who cannot have MRI examinations. MRI has significant contribution in evaluating the morphology and function of the RV. This is a significant advantage for ARVC/D and also for other diseases such as decompensated RV function from pulmonary hypertension in the setting of chronic pulmonary embolism. Another advantage of MRI is the ability to evaluate RV fibrous tissue, which enhances in a delayed fashion, and RV fat.

Variant: Suspected Myocardial Infiltrative Disease

Sarcoid and amyloid are the most common infiltrative diseases involving the myocardium. Sarcoid is a granulomatous disease that can affect any organ and has a wide spectrum of clinical manifestations. Cardiac sarcoid may be symptomatic or asymptomatic. The most common clinical presentations are heart block, dilated CM, and ventricular arrhythmias. Because the yield of endomyocardial biopsy for the suspected diagnosis is low from patchy disease, noninvasive imaging is often pursued. Echo and MRI are the most commonly used imaging modalities, although CT is often used in search of mediastinal adenopathy and lung abnormalities. PET using 18-F-fluoro-2-deoxyglucose (FDG-PET) may offer earlier detection of cardiac sarcoidosis and indicate areas of active disease. MRI with late gadolinium enhancement has shown higher sensitivity in the detection of cardiac sarcoidosis than standard clinical evaluations (ECG, thallium scintigraphy, and echo). Early treatment is crucial in improving symptoms and prognosis.

Amyloidosis is a systemic condition characterized by the extracellular deposition of amyloid into one or more organ systems. Cardiac deposition leads to an infiltrative/restrictive CM. On imaging, the LV is hypertrophied, the valves and the interatrial septum are often thickened, and the LV exhibits diastolic dysfunction. MRI has an increasing role in the diagnosis of amyloid with characteristic patterns of myocardial delayed enhancement.

Chagas disease is rare in the United States but may be seen in the southern states and in California, especially in immigrants and visitors from Central and South America. Migratory movements can raise the suspicion of this parasitic infiltrative myocardial disease. CMR has emerged as the noninvasive tool to evaluate the myocardial fibrosis typical of Chagas disease.

Iron overload CM is considered an infiltrative cardiomyopathy, which results in diastolic and systolic dysfunction. It may be primary with a genetic basis as in hemochromatosis. It may also be secondary due to various transfusion dependent anemias. Advances in cardiac MRI have allowed not only the diagnosis but also the quantification of myocardial iron with T2* evaluations for the purposes of early diagnosis and guiding chelation therapy.

Variant: Suspected Hypertrophic Cardiomyopathy

Hypertrophic CM (HCM) is a genetically based myocardial disease with a wide spectrum of genotypic abnormalities and phenotypic presentations. The distribution of the hypertrophy may be concentric, involving the entire LV, or may asymmetrically affect the LV. Most commonly, the septum or apex is hypertrophied if the distribution is asymmetric. Although echo remains the mainstay modality for diagnosis, diagnostic imaging can be performed with CT and MRI as well. LV outflow obstruction and systolic anterior motion of the mitral valve are characteristic features of hypertrophic obstructive cardiomyopathy (HOCM) and can be evaluated by echo and CMR. True short-axis views of the LV by CMR can be helpful in obtaining accurate measurement of LV wall thickness, one of several criteria for ICD placement. MRI may be particularly useful in distinguishing hypertensive CM from symmetric HCM by characteristic enhancement patterns. Fabry disease can be considered when there is symmetric hypertrophy, and MRI may also be helpful in differentiating Fabry disease and HCM.

Variant: Suspected Acute/Subacute Myocardial Disease

Acute and subacute nonischemic myocardial diseases can cause troponin elevation and mimic ischemic causes of chest pain. Myocarditis is inflammation of the myocardium and may have a viral etiology or be idiopathic. Echo might show global or regional wall motion abnormalities, which may be concerning for ischemia. CMR provides additive information with the ability to image tissue edema and characteristic midwall or subepicardial patterns of delayed enhancement. This can be very useful in differentiating troponin elevation in acute myocardial infarction. In addition, associated pericardial thickening or inflammation can be evident.

Stress CM, also known as takotsubo CM, produces transient myocardial dysfunction, which resolves in a period of days to weeks. The wall motion abnormalities are regional, dyskinetic, and in a non-coronary distribution. The most common variant is apical ballooning, with occasional variations of basal and mid-ventricular ballooning. The patient may present with acute chest pain worrisome for myocardial infarction, and imaging is helpful to diagnose this condition in the absence of flow-limiting coronary artery disease. Cardiotoxic medications such as chemotherapeutic agents can have either temporary or permanent effect on myocardial function and should also be considered in acute/subacute development of systolic cardiac dysfunction.

Suspected Familial or Genetically Transmitted Cardiomyopathy

Familial and/or genetically transmitted cardiomyopathies are increasingly recognized, and several have been described in the text above. Heart failure in complex congenital heart diseases is multifactorial and may have a genetic basis, but this is beyond the scope of this document. The imaging for these cardiomyopathies is quite varied depending on the particular disease and therefore will not be covered in the variant tables. The most commonly recognized myocardial diseases with a genetic basis are HCM, dilated CM, and ARVC/D. Less common are deposition diseases such as Fabry disease and hemochromatosis. Isolated left ventricular noncompaction is a rare but increasingly recognized congenital CM

characterized by prominent trabecular, deep intertrabecular recesses, and thickened myocardium with 2 distinct layers (compacted and noncompacted).

Summary

- Imaging plays an important role in the diagnosis of nonischemic cardiomyopathies.
- Newer technologies involving CT and MRI have shown promise in improving earlier detection and improved accuracy of diagnosis of several cardiomyopathies.
- Although it is expected that traditional imaging modalities such as echo will continue to play a primary role in nonischemic cardiomyopathies, MRI in particular is expected to play an increasing role in both diagnosis and management.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Abbreviations

- CT, computed tomography
- CTA, computed tomography angiography
- FDG-PET, 18-F-fluoro-2-deoxyglucose positron emission tomography
- MRI, magnetic resonance imaging
- Tc-99m V/Q, technetium-99m ventilation-perfusion scan
- US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☐	<0.1 mSv	<0.03 mSv
☐☐	0.1-1 mSv	0.03-0.3 mSv
☐☐☐	1-10 mSv	0.3-3 mSv
☐☐☐☐	10-30 mSv	3-10 mSv
☐☐☐☐☐	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Disease/Condition(s)

Nonischemic myocardial disease

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Cardiology

Emergency Medicine

Family Practice

Internal Medicine

Radiology

Surgery

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of initial radiologic examinations for patients with nonischemic myocardial disease with clinical manifestations (ischemic cardiomyopathy already excluded)

Target Population

Patients with suspected or known nonischemic myocardial disease

Interventions and Practices Considered

1. Magnetic resonance imaging (MRI)
    - Heart function and morphology without and with contrast
    - Heart function and morphology without contrast
    - Chest without and with contrast
    - Chest without contrast
2. Ultrasound (US) echocardiography (echo)
    - Transthoracic resting
    - Transesophageal

3. Computed tomography (CT)
    - Heart function and morphology with contrast
    - Chest without contrast
    - Coronary calcium
4. Coronary angiography with ventriculography
5. Technetium (Tc)-99m ventilation-perfusion (V/Q) scan lung
6. X-ray, chest
7. 18-F-fluoro-2-deoxyglucose positron emission tomography (FDG-PET) heart
8. Arteriography, pulmonary

Major Outcomes Considered

Utility of radiologic examinations in differential diagnosis

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Procedure

Staff will search in PubMed only for peer reviewed medical literature for routine searches. Any article or guideline may be used by the author in the narrative but those materials may have been identified outside of the routine literature search process.

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches.

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 10 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence (study quality) for each article included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Rating Appropriateness

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distribute surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. The surveys are completed by panelists without consulting other panelists. The appropriateness rating scale is an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "usually not appropriate"; 4, 5, or 6 are in the category "may be appropriate"; and 7, 8, or 9 are in the category "usually appropriate." Each panel member assigns one rating for each procedure for a clinical scenario. The ratings assigned by each panel member are presented in a table displaying the frequency distribution of the ratings without identifying which members provided any particular rating.

If consensus is reached, the median rating is assigned as the panel's final recommendation/rating. Consensus is defined as eighty percent (80%) agreement within a rating category. A maximum of three rounds may be conducted to reach consensus. Consensus among the panel members must be achieved to determine the final rating for each procedure.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is proposed as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

This modified Delphi method enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive influence from fellow panelists in a simple, standardized and economical process. A more detailed explanation of the complete process can be found in additional methodology documents found on the ACR Web site (see also the "Availability of Companion Documents" field).

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Selection of appropriate radiologic imaging procedures for nonischemic myocardial disease with clinical manifestations (ischemic cardiomyopathy already excluded)

Potential Harms

Gadolinium-based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are low as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Contraindications

Contraindications

Patients with implantable cardioverter-defibrillators (ICD) cannot have magnetic resonance imaging (MRI) examinations.

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Living with Illness

Staying Healthy

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

Bibliographic Source(s)

Mammen L, Woodard PK, Abbara S, Dorbala S, Javidan-Nejad C, Julsrud PR, Kirsch J, Kramer CM, Krishnamurthy R, Laroia AT, Shah AB, Vogel-Claussen J, White RD, Expert Panel on Cardiac Imaging. ACR Appropriateness CriteriaÂ® nonischemic myocardial disease with clinical manifestations (ischemic cardiomyopathy already excluded). [online publication]. Reston (VA): American College of Radiology (ACR); 2013. 11 p. [67 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2013

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Cardiac Imaging

Composition of Group That Authored the Guideline

Panel Members: Leena Mammen, MD (*Principal Author*); Pamela K. Woodard, MD (*Panel Chair*); Suhny Abbara, MD (*Panel Vice-chair*); Sharmila Dorbala, MD; Cylen Javidan-Nejad, MD; Paul R. Julsrud, MD; Jacobo Kirsch, MD; Christopher M. Kramer, MD; Rajesh Krishnamurthy, MD; Archana T. Laroia, MD; Amar B. Shah, MD; Jens Vogel-Claussen, MD; Richard D. White, MD

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site .
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2013 Apr. 1 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in PDF from the ACR Web site .
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Patient Resources

None available

NGC Status

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